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Abstract:
We report theoretical and experimental studies of ambipolar spin diffusion in a semiconductor. A circularly polarized laser pulse is used to excite spin-polarized carriers in a GaAs multiple quantum-well sample at 80 K. Diffusion of electron and spin densities is simultaneously measured using a spatially and temporally resolved pump-probe technique. Two regimes of diffusion for spin-polarized electrons are observed. Initially, the rate of spin diffusion is similar to that of density diffusion and is controlled by the ambipolar diffusion coefficient. At later times, the spin diffusion slows down considerably relative to the density diffusion and appears to be controlled by a nonconstant (decreasing) spin-diffusion coefficient. We suggest that the long-time behavior of the spin density can be understood in terms of an inhomogeneous spin-relaxation rate, which grows with decreasing density. The behavior of the spin-relaxation rate is consistent with a model of D'yakonov-Perel' relaxation limited by the Coulomb scattering between carriers.